

THURSDAY, MARCH 6, 1902.

*THE VOYAGE OF THE "VALDIVIA."*

*Aus den Tiefen des Weltmeeres, Schilderungen von der deutschen Tiefsee-expedition.* Von Carl Chun. (Jena: Gustav Fischer, 1900.) Lief. i.-xii. Price 18 mk.

ON the return of the German deep-sea expedition, it was decided to issue a popular account of the voyage and its results. Naturally this task fell to the leader, and in the volume before us Prof. Chun acquits himself of it.

The work opens with a short review of the history of deep-sea exploration, from the discovery by Sir John Ross in the year 1818 of living brittle-stars in 1000 fathoms of water to the outfitting of the German expedition in 1898—pages which will be read in this country with a justifiable pride indeed, but also with the conviction that exertion is needed if we are still to hold our own in scientific exploration. In enumerating the problems which yet remain to be solved, and for the discussion of which his expedition was to furnish material, Prof. Chun mentions the bionomics and embryology of deep-sea animals, the distribution equatorwards of polar organisms, and bipolarity, but he does not here refer to a question of considerable interest which has been greatly enlightened by the *Valdivia's* researches, the vertical distribution of the mesoplankton, which has been found, by the German expedition and by Dr. G. H. Fowler independently at almost the same time, practically to cease at about 1000 fathoms—a result which agrees neither with the view previously held in some quarters that pelagic life extended throughout the depth of the ocean, nor with the opposite opinion that it did not exist below two or three hundred fathoms.

The route of the cruise was determined by the decision to explore, as far as possible, portions of the ocean the deep-water fauna of which was as yet imperfectly known. Two of the most important of these being the South Atlantic and a great part of the Indian Ocean, the course decided upon was one which, passing through the Faroe Channel and thence southwards to the Canaries, followed roughly the western coast of Africa to the Cape, then struck south-west to Bouvet Island and south-east from Bouvet Island to the neighbourhood of Enderby Land, traversed the length of the Indian Ocean to the Nicobars, passing Kerguelen, New Amsterdam and Sumatra on the way, crossed from the Nicobars by Ceylon, the Maldives, the Chagos and the Seychelles to Dar-es-Salaam, and finally led back along the east coast of Africa, through the Red Sea and Suez Canal, to the Mediterranean and so home. Besides Prof. Chun, the expedition comprised ten scientific members, a photographer and a conservator. The vessel chosen was the *Valdivia*, a Hamburg to West Indies liner of 2176 tons register, and considerable alterations were made to fit her for the voyage, among others the fitting up of a large ice-room, which was found very useful in enabling deep-sea animals to be examined alive by being kept at a low temperature. The scientific equipment was very elaborate, and certain practical details are worth noting. Indiarubber accumulators, used to take the weight of the nets and their wire, were

perished by the heat of the tropics, though fortunately others of steel spring were at hand. The "Blake" dredge proved less serviceable than a trawl, its iron frame cutting too deep into the ooze. The bucket of the vertical net was of glass and without filtering surfaces, whereby a smaller quantity of plankton was gotten, but in better condition. No doubt the quantitative net, built on Hensen's pattern, which was carried was provided with a porous bucket. Both Negretti and Zambra's up-setting thermometer and one of the Siemens electrical type proved useful, but the latter is said to need further improvements.

The history of the voyage is sketched in a series of chapters. These are written in a light and popular vein, and are beautifully illustrated by photographs of places and natives, but only a few points in them call for notice here. The important observations began when the Canaries had been passed. In the Guinea Stream, the low specific gravity of the water was found to be connected with a peculiarity of the plankton, the spines and other processes of which are longer than those of the forms found in the north and south equatorial streams. Dredging here gave poor results, but the deep-sea plankton is very rich. In lat. 25° 26' S. was discovered, in 936 fathoms, a new bank, believed to form part of a ridge (the "Walfish ridge"), which parts the colder southern waters from the tropics, much as the Iceland ridge fends off the Arctic waters. The fauna of this bank is very rich. Careful dredgings were also made on the Agulhas bank, from which valuable results may be expected. There appears to be here an intermingling of Atlantic and Indian forms with typical Antarctic species, and Prof. Chun suggests that the latter are relics of a time when these waters were colder than at present.

One of the most important results of the expedition was the rediscovery of Bouvet Island in lat. 54° 26' S. and long. 3° 24' E. The *Valdivia* was only able to establish the existence of a single volcanic island some five miles by four, covered with an immense glacier, but the possibility is not excluded that a second may exist, corresponding to Norris's "Thompson Island." The search for this island in stormy weather amid mist and icebergs seems to have been a fine piece of work. Dredgings in the neighbourhood revealed a very rich fauna, intermediate between that of the Magellan region and that of Kerguelen, but with many new forms. Bouvet Island appears to be near the point of a tongue of cold water which extends northwards from the Antarctic region. On leaving it, the *Valdivia* coasted along the edge of the drift-ice which marks this tongue, in a south-easterly direction, till she was confronted with the edge of the pack-ice in the neighbourhood of Enderby Land. During the whole of this course, the water was of great depth, varying from 2000 to 3000 fathoms. The temperature curve was also very interesting. Owing to the presence of ice, the surface water is considerably cooler than that of intermediate depths, the actually coldest layer (about -1°·5 C.) being at 30-40 fathoms. Below this the temperature rises, till at 300-400 fathoms it is 1°·7 C. Then it falls gradually and, at the bottom, is -5° C. Naturally, a number of icebergs were met with in this region, mostly of table form well known in the Antarctic and often of immense size. After a number of pages

devoted to an account of the origin and destruction of these bergs, Prof. Chun passes to a consideration of the Antarctic plankton. The *Valdivia's* researches were made at the height of the summer, when the surface fauna and flora were at their richest. In many respects they resemble those of the Arctic region, the most striking difference being the complete absence of Ceratium and the rarity of other dinoflagellates, the place of which was taken by immense numbers of diatoms, especially those of the genus *Chaetoceras*. The greatest richness of the plankton was reached at 20-40 fathoms, the poverty of the surface waters being probably due to their lower specific gravity owing to the presence of melting ice. A twilight flora (*Schattenflora*), such as is found in the lower layers of the surface waters in tropical seas, is wanting in the Antarctic. On December 17, the ship was brought to a stand by the pack-ice some hundred miles north of Enderby Land in 2300 fathoms, and bore away north-west to Kerguelen. A dredging taken shortly after this showed a rather rich fauna and brought up a glacier-borne boulder of red sandstone, proving that Enderby Land is not of purely volcanic origin.

The voyage northwards across the Indian Ocean, which was saddened by the death of Dr. Bachmann, the physician and bacteriologist of the expedition, does not appear to have produced any very startling results. After leaving Padang in Sumatra, researches were made on the deep basin (some 1000 fathoms) between Sumatra and the Mentawi Islands. This basin is separated from the open ocean by a ridge of only 400 fathoms, on which the group is situated, and the bottom temperature is therefore higher (5.9 C.) than that outside the islands. At the same time there is a very rich surface flora. Consequently the bottom fauna is extraordinarily rich. In this neighbourhood a specimen of *Spirula* was taken in perfect condition. A short visit to Suvadiva Atoll in the Maldives gives the author an opportunity for some remarks on that group. Since this visit, however, our formerly scanty knowledge of the Maldivian Islands has been so vastly increased by Mr. Stanley Gardiner's expedition that the observations of the *Valdivia* are deprived of any value they might otherwise have had. Prof. Chun's ethnological conclusions are not very different from Mr. Gardiner's, but we very much doubt whether the latter author would accept the suggestion that the Maldives are built on a submarine mountain range. On the voyage to Diego Garcia, the very important discovery was made that the Chagos group and the Maldives are connected by a bank in 1100 to 1500 fathoms, this bank being sundered from that on which the Seychelles lie by a narrow channel only. The last section of the voyage in the Indian Ocean, that along the East African coast from Dar-es-Salaam northwards, in 500-700 fathoms, yielded the richest dredgings in the whole cruise.

At the end of the volume are some chapters on the deep-sea animals captured by the expedition and on general considerations concerning the oceanic fauna and flora. The "catch" was, on the whole, very much what might have been expected, and seems to contain many interesting forms, but few startling novelties. Hexactinellid sponges, actinozoa and echinoderms are naturally numerous, and giant forms of ostracoda, cirripedia and larvacea were taken. Deep-sea ctenophores were dis-

covered, and some of the fish are perhaps even more bizarre than those that were already known from the deep sea. Naturally, the collections have not yet been sufficiently examined to enable general conclusions to be drawn from them with certainty, but Prof. Chun seems to incline to the view that the bottom faunas of the Arctic, Antarctic, Atlantic and Indian areas entitle them to be considered as distinct regions, in spite of the marked convergence between the members of the first pair and the identity of many species in the second. The surface fauna, and especially the surface flora, is much more peculiar in each region than the fauna of the bottom, but that of intermediate depths has a very uniform character in all, and, since many animals pass from the surface to lower layers of the water at fixed times of the year, it is possible to account for the cosmopolitan distribution of certain forms. On the subject of bipolarity, Prof. Chun is at present disinclined to pass an opinion.

To sum up in a few words the results of such an undertaking as the German deep-sea expedition is difficult. But it may, we think, be fairly said that not only have two or three discoveries of the first importance been made—such as the soundings in the neighbourhood of the Chagos group and off Walfish Bay, the "tailing off" of the pelagic fauna below 1000 fathoms, and the observations regarding Bouvet Island, but a mass of valuable information has been gathered which, when digested and discussed in the light of the facts accumulated by other expeditions, will set forward very notably our knowledge of the biology and physiography of the sea.

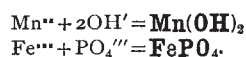
It is impossible to end a notice of this work without referring to the beautiful way in which it is brought out. The print, the margins, the numerous and artistic photographs, and the headpieces quaintly contrived out of representations of sea animals are all beyond praise and can only be made possible in a work issued at the price of the present one by a wide popular appreciation in Germany of the results of the expedition. What sort of public would such a work find in English?

L. A. B.

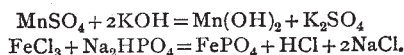
#### CHEMICAL ANALYSIS.

*Practical Chemistry.* By Abegg and Herz. Translated by H. T. Calvert, B.Sc. Pp. xiii + 118. (London: Macmillan and Co., Ltd.) Price 6s.

THIS little work, which deals mainly with qualitative analysis, is based upon the principles of modern physical chemistry. The equations representing "reactions in solution" are written in the ionic form, thus:—



This method of representing reactions in solution as being entirely dependent upon the "ions" has its advantages, but it also has certain disadvantages. In most text-books the above equations would be represented by the action of definite salts, as, e.g.,



When expressed in the latter form, students are apt to